

Remarks

The Applicants have amended Claim 7 to recite that there is in fact vanadium present in the steel slab and that the amount of vanadium is 0.004 – 0.3 percent. Support may be found in a variety of locations, such as in paragraph [0028] and Table 1, wherein a variety of quantities of vanadium are disclosed down to and including 0.004 percent.

The Applicants acknowledge the rejection of Claims 7 to 11 under 35 U.S.C. §103 over EP '685. The Applicants respectfully submit that Claims 7 – 11 are patentable over EP '685 for the reasons set forth below.

The Applicants first note that an important feature of Claim 7 is the value of the surface roughness (Ra), which is defined as 0.3 μm or less, to be secured through optimization of conditions concerning skin-pass rolling (roughness of rolls and rolling reduction ratios) and pickling (temperature, time, pickling solution and the like). One large difference from the prior art lies in the Applicants' finding that, as a result of defining the surface roughness as mentioned above, brittle resistance to secondary processing of a finished cold-rolled steel sheet has been improved, even when the compositions, hot-rolling conditions, cold-rolling reduction ratios and heat treatment conditions of the steel sheet of this invention are the same as those of the prior art.

It is an additional new discovery by the Applicants that, by the definition of the crystal grain size of the finished cold-rolled steel sheet as 40 μm or less, brittle resistance to secondary processing and surface roughness are able to be further improved.

The surface roughness (Ra) as claimed herein is also important to distinguish this invention over the art. Specifically, having the appropriate surface roughness of a cold-rolled annealed sheet is effective in the improvement of brittle resistance to secondary processing of the steel sheet. Further, this invention enhances surface roughness (Ra) by adjusting the conditions of skin-pass rolling

(roughness of rolls and rolling reduction ratios) and pickling (temperature, time, pickling solution and the like) in the manufacturing process. Neither EP '685 nor JP '208 disclose that the state of surface roughness of a finished cold-rolled sheet improves brittle resistance to secondary processing of the steel sheet, although there is defined, in EP '685 and JP '208 mechanical properties and composition of a steel sheet.

The Applicants also discovered that toughness is improved by substituting a portion of Ti by V and by further adding B. On the other hand, no range of V content is defined in EP '685 and JP '208 (also, there are no disclosures in their Inventive Examples). Such being the case, the V content in the claims herein is defined to be from 0.004% to 0.3%.

EP '685 is based on the discovery of an improvement of a steel sheet in securing ridging resistance which is achieved by only defining the composition. In the meantime, JP '208 found that, by limiting the surface roughness Ra in a range of 0.1 to 0.5 μm , it is possible to reduce cracking generated while processing a bellows pipe, wherein the cracking is considered to be caused by the unevenness of the surface of a steel pipe material.

Moreover, neither EP '685 nor JP '208 mention the operations that surface roughness (Ra) and a crystal grain size of a finished cold-rolled steel sheet improve the brittle resistance to secondary processing of the steel sheet. Therefore, it is not possible for a person of ordinary skill in the art to realize the claimed features of this invention from EP '685 and/or JP '208.

The Applicants therefore respectfully submit that EP '685 is inapplicable to Claims 7 – 11. EP '685 utterly fails to disclose, teach or suggest the claimed amount of vanadium and/or that such a claimed amount of vanadium would have any impact on the characteristics of the steels produced in accordance with the method recited in Claims 7 – 11. The Applicants therefore respectfully request that the rejection of Claims 7 – 11 based on EP '685 be withdrawn.

The Applicants acknowledge the rejection of Claim 7 under 35 U.S.C. §103 over JP ‘208. Again, the Applicants respectfully submit that JP ‘208 is inapplicable to Claim 7. As noted above, Claim 7 recites the specified amount of vanadium in an amount of 0.004 to 0.3%. JP ‘208 utterly fails to disclose, teach or suggest the presence of vanadium, much less the claimed amount of vanadium. JP ‘208 therefore inherently fails to disclose, teach or suggest the physical characteristics brought about by the claimed amount of vanadium. Withdrawal of the rejection is respectfully requested.

The Applicants acknowledge the rejection of Claims 8 – 10 under 35 U.S.C. §103 over the hypothetical combination of EP ‘685 with JP ‘208. Inasmuch as both of JP ‘208 and EP ‘685 utterly fail to disclose, teach or suggest the claimed amount of vanadium, any methodology or product that results from the hypothetical combination of those two references would still fail to teach or suggest the invention as recited in Claims 8 – 10. Withdrawal of the rejection is therefore respectfully requested.

The Applicants acknowledge the rejection of Claims 12 – 14 under 35 U.S.C. §103 over the further hypothetical combination of the Applicants’ “admitted prior art” on pages 1 – 3 of the Specification with EP ‘685 and JP ‘208. The Applicants respectfully submit that hypothetically combining that “admitted prior art” with the other two references would still fail to teach or suggest the invention as recited in Claims 12 – 14. There would still be utterly no teaching or suggestion with respect to the claimed amount of vanadium and, therefore, inherently is a failure to disclose, teach or suggest the Applicants’ physical characteristics brought about as a result of use of such vanadium in the claimed amount. Withdrawal of the rejection is respectfully requested.

Finally, the Applicants note with appreciation the Examiner’s helpful comments with respect to the equations set forth in Table 1. The Applicants have substituted new equations that are

complete. Entry into the Official File is respectfully requested.

In light of the foregoing, the Applicants respectfully submit that the entire Application is now in condition for allowance, which is respectfully requested.

Respectfully submitted,



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Table 1

No.	C	Si	Mn	P	S	Cr	Al	Ni	Cu	Co	Nb	Ti	N	B	V	Ca	$\frac{18Nb}{(C+N)+2(Ti)} \leq 0.05 \leq \frac{0.55Cu+0.85Co+ND}{(C+N)} \leq 0.30$	Reference
A1	0.008	0.40	0.30	0.028	0.005	18.0	0.002	0.001	0.0010	0.0010	0.3300	0.001	0.008	15 ppm	0.010	11 ppm	0.002	Invention
A2	0.004	0.10	0.30	0.035	0.003	16.5	0.003	0.001	0.0010	0.0010	0.3500	0.080	0.018	18 ppm	0.121	18 ppm	0.002	Invention
A3	0.005	0.06	0.15	0.025	0.005	17.8	0.001	0.001	0.0020	0.0005	0.0010	0.270	0.007	21 ppm	0.004	20 ppm	0.002	Invention
A4	0.004	0.11	0.15	0.027	0.006	18.0	0.002	0.100	0.0010	0.0010	0.0006	0.281	0.007	40 ppm	0.110	35 ppm	0.101	Invention
A5	0.004	0.10	0.15	0.030	0.005	18.0	0.002	0.001	0.0050	0.0010	0.0010	0.310	0.009	4 ppm	0.004	18 ppm	0.002	* C.E.
A6	0.004	0.11	0.14	0.026	0.005	18.1	0.006	0.012	0.0010	0.0005	0.0007	0.254	0.007	93 ppm	0.004	22 ppm	0.012	Invention
A7	0.004	0.11	0.15	0.027	0.006	18.0	0.002	0.001	0.0010	0.0010	0.0010	0.251	0.007	110 ppm	0.006	12 ppm	0.002	* C.E.
A8	0.005	0.06	0.15	0.025	0.005	17.8	0.003	0.001	0.3000	0.0010	0.0010	0.270	0.007	21 ppm	0.005	15 ppm	0.018	Invention
A9	0.004	0.11	0.15	0.027	0.006	18.0	0.002	0.001	0.0010	0.1000	0.0010	0.270	0.007	21 ppm	0.005	22 ppm	0.086	Invention
A10	0.005	0.10	0.14	0.025	0.005	18.1	0.004	0.150	0.0200	0.0400	0.0001	0.264	0.006	20 ppm	0.061	0 ppm	0.185	Invention
A11	0.006	0.11	0.13	0.024	0.006	18.0	0.003	0.150	0.0040	0.1000	0.0020	0.255	0.008	21 ppm	0.005	22 ppm	0.235	Invention
A12	0.006	0.11	0.13	0.024	0.006	18.0	0.003	0.300	0.5100	0.2000	0.0030	0.218	0.006	30 ppm	0.068	16 ppm	0.498	Invention
A13	0.003	0.19	0.09	0.023	0.004	25.0	0.013	0.150	0.0200	0.0400	0.2300	0.001	0.007	13 ppm	0.003	20 ppm	0.185	* C.E.
A14	0.005	0.06	0.15	0.025	0.005	17.8	0.001	0.001	0.0020	0.0040	0.0010	0.270	0.007	21 ppm	0.004	0 ppm	0.005	Invention
A15	0.003	0.06	0.21	0.022	0.003	18.1	0.001	0.001	0.0020	0.0005	0.0010	0.270	0.007	26 ppm	0.004	10 ppm	0.002	Invention
A16	0.005	0.04	0.15	0.025	0.005	17.8	0.001	0.001	0.0020	0.0005	0.0010	0.270	0.007	21 ppm	0.004	25 ppm	0.002	Invention
A17	0.009	0.06	0.05	0.025	0.005	18.0	0.001	0.001	0.0020	0.0040	0.0090	0.270	0.007	21 ppm	0.005	32 ppm	0.005	Invention
A18	0.004	0.22	0.080	0.026	0.006	17.6	0.002	0.050	0.0020	0.0030	0.0900	0.150	0.007	17 ppm	0.110	20 ppm	0.053	Invention
A19	0.001	0.40	0.01	0.013	0.002	14.8	0.080	0.001	0.2000	0.2000	0.0010	0.052	0.001	30 ppm	0.101	0 ppm	0.182	Invention
A20	0.008	0.81	0.31	0.010	0.001	11.8	0.210	0.001	0.0010	0.0010	0.3300	0.013	0.003	15 ppm	0.150	0 ppm	0.002	Invention
A21	0.005	0.08	0.11	0.010	0.005	21.0	0.030	0.001	0.1100	0.0210	0.0010	0.150	0.001	40 ppm	0.053	10 ppm	0.025	Invention
A22	0.008	0.01	0.11	0.230	0.001	17.1	0.001	0.130	0.0920	0.0200	0.0011	0.221	0.015	23 ppm	0.331	0 ppm	0.152	* C.E.
A23	0.005	0.21	0.12	0.018	0.005	17.0	0.021	0.131	0.0001	0.0310	0.0001	0.000	0.008	13 ppm	0.110	0 ppm	0.157	* C.E.
A24	0.005	0.22	0.11	0.018	0.005	16.8	0.030	0.110	0.0001	0.0210	0.2200	0.290	0.008	13 ppm	0.110	0 ppm	0.128	* C.E.
A25	0.002	0.08	0.20	0.023	0.005	16.9	0.033	0.001	0.1310	0.0200	0.0010	0.250	0.011	0 ppm	0.002	0 ppm	0.025	* C.E.
A26	0.008	0.12	1.00	0.015	0.005	9.8	0.020	0.110	0.2000	0.0500	0.0500	0.180	0.015	13 ppm	0.110	10 ppm	0.164	* C.E.

*C.E. = Comparative Example